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THE TECHNOLOGY TRANSFER APPLICATION
IN
THE REPUBLIC OF INDONESIA

by

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The Technology Transfer Application
in
The Republic of Indonesia

by

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ABSTRACT

The main emphasis of this thesis is the examination of technology transfer from a theoretical perspective and comparison of this perspective with its application in the Republic of Indonesia. The elements of a transfer mechanism concept such as organization, project, documentation, distribution, linker, capacity, credibility,willingness and rewards are being used for the examination. The role of The Body of The Assessment and Application of Technology (BPPT) as the linker between the source of technology from foreign countries and technology users in Indonesia is observed in particular. It is concluded that the technology transfer process is being succesfully conducted from theoritical perspectives, and a recommendation is proposed to the BPPT and its associated linker networks in order to maintain its existing performance.

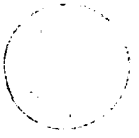

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TABLE OF CONTENTS

I. INTRODUCTION

Indonesia is a relatively new nation, its independence was declared in August 17,1945. As a new nation the government of Indonesia is making efforts to develop the country, as it is far behind compared to developed countries.

Before 1965 there was no structured national plan of development in Indonesia because the country had been busy with internal turmoil caused by such factors as separatism, religious fanatism and ideological conflicts. In 1965 the country gained stability, and awareness of the need for national development increased. In 1969 the government started the first five year development program.

Most developed countries are supported by strong industry, which is why the long term goal of the Indonesian development program is to have an economic structure based on strong industry and strong agriculture as well. However, technology is a key factor in any industrial activity and it is obvious that most technology is not readily available in Indonesia, and will not always be available to implement for the development program.

Developing our own technology would not necessarily allow us to catch up with the developed countries since the starting point would be different and the objectives of development might be achieved in a much longer time scale. Hence the government has adopted a technology transfer policy for implementing the development program. A Body of the Assessment and Application of Technology (BPPT) was created on August 21,1978 in order to serve as the link between the source of technology from other countries and the potential users in Indonesia.

The purpose of this thesis is to examine technology transfer from a theoretical perspective and compare it with the BPPT program. If the comparison reveals functions that could be added to existing BPPT procedures to benefit National Development, recommendations will be made to address such change.

The theoretical concept of technology transfer is described in the beginning of this paper (Chapter II) and the transfer mechanism is the highlight of the concept. This mechanism represents the interaction of people that determines the process of the transfer flow. The speed and smoothness of the transfer flow are the important characteristics influenced by the transfer mechanism. The elements of the transfer

mechanism are : organization, projects, documentation, distribution, linker, capacity, credibility, willingness and reward. The linker concept is the most important element of the transfer mechanism since it plays the central role between the source and the user of the knowledge as well as shaping the harmony of the elements and influencing the characteristic of the transfer flow. The linker concept will described fully in Chapter II.

The background of National Development in Indonesia will be presented in Chapter III, and Indonesia's technology transfer linker mechanism, the BPPT, will be discussed in Chapter IV. Subsequent chapters will present the problems and contributions of technology transfer with respect to the National Development (Chapter V) and the conclusion is presented in Chapter VI.

II. CONCEPT OF TECHNOLOGY TRANSFER

A. GENERAL

Technology transfer phenomena cannot be separated from technological innovation, which is broadly defined, as to include an idea which is perceived by the individual to be a new method, means, or capacity to perform a particular activity. Technology transfer is just one aspect of technological innovation and defined as " a purposive, conscious effort to move technical devices, materials, methods and/or information from the point of discovery or development to new users" [Ref. 3].

In management terms, technology transfer implies the management of change that consists of bringing new ideas, knowledge, process and products to the attention of those who might use them and then encouraging trial and application [Ref. 1]. A simple way of describing technology transfer process can be described in the following diagram [Ref. 2].

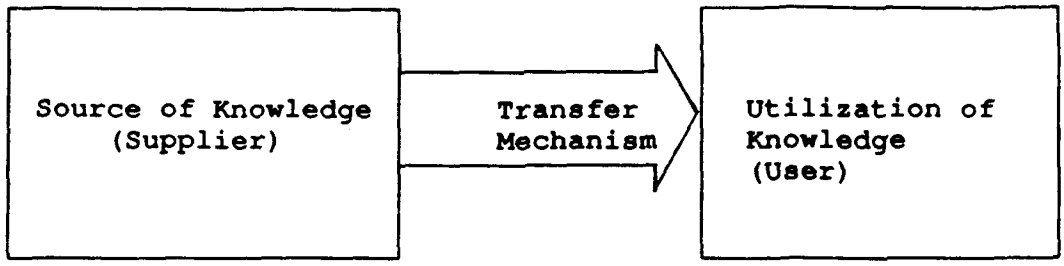


Fig. 1 A simplified view of Technology Transfer Process.

For movement of the knowledge, the process needs a transfer mechanism that represents the interaction of people. The mechanism need not be independent, but may be incorporated in either the supplier or user environment. The elements of a transfer mechanism can be divided into categories as follows [Ref. 1] :

1. **The Formal Elements that they are relatively manageable and identifiable.**

a. Organization

Characteristics of both the formal and informal organization that impact on transfer. This includes such things as organizational structure, managerial climate, make-up of the work force, policies, etc.

*b. **Project***

The nature of the project, procedures and standards for selection, standards for approval, response to the potential user need, assignment of the resources, the review system, etc.

*c. **Documentation***

Reports, technical notes, drawings, new articles, video tapes, storage systems, etc., that are in documentation form. Language, timing, the ability to express, and the understanding level of the potential user are of primary importance.

*d. **Distribution***

Where does the information go ? How does it move ? How and by whom is it received ? Is there follow up ? Can it be controlled ?

2. **The informal elements are concerned with things which are not clearly identifiable, nor precisely manageable.**

*a. **Linker***

An intermediary person or organization between the source of knowledge and the application of knowledge.

*b. **Capacity***

A wide spectrum of traits of involved persons and organizations, both source and user, which might influence the transfer movement.

c. Credibility

Credibility depends upon an assessment of the reliability of the information, its source and of the intermediary, by the receiver; or an assessment by the source of the ability of the receiver to understand or use the information. In a transfer transaction all parties are both receiver and generator of at least part of the information which passes between them.

d. Willingness

Desire or resistance to accept and use, or the degree of effort expanded to transmit or respond to need, are essential to this element.

e. Reward

Reward is a reason for action or inaction. It is the foundation. It is the foundation for "Why should I?" or "Why shouldn't I?". The perceived degree or reward, positive or negative, determines the force cause for action.

B. THE IMPORTANCE OF THE LINKER ELEMENT

The linker element plays a central role in the technology transfer process since it operates at the interface between the knowledge and the need. The model is shown in the following diagram [Ref. 3].

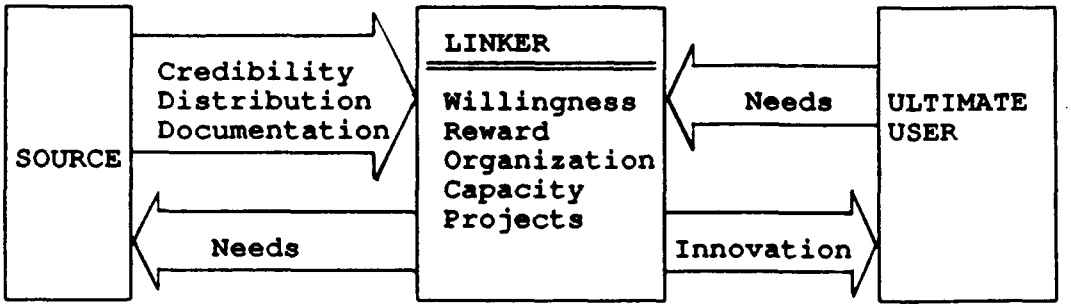


Fig. 2 Linker model of transfer mechanism

Basically, the main function of the linker is to provide communication between the source and the user, and the linking activities premise could be described as follows [Ref. 1].

1. Linking, while immensely important in technology transfer, is primarily important to provide the interaction between source of information and users.

2. Linking networks, similarly, provide an important liaison function of immense importance, but the product from the networks is worthless unless action results.

3. An emphasis on linking, networks, and change agent actions generates the assumption that they actually transfer the technology, while they may, in fact, work against the transfer by lessening emphasis on the responsibility of key managers of production functions.

4. The primary responsibility for taking action to accomplish effective utilization of new technology rests with managerial personnel in both technology generating and using organizations.

In the action role, a linker performs in a relatively risk-free environment. While successful linkage is dependent to a large extent on effecting a good transaction of the right people or organizations, the linker assumes little or no risk. Any risk the linker might feel may well derive from their status as the opinion leader.

III. INDONESIAN DEVELOPMENT

A. BACKGROUND

Indonesia is a relatively new nation, whose independence was declared in August 17, 1945 after 350 years under the Dutch rule and 3.5 years by Japan during world war II. Its real freedom was gained after fighting with the Dutch in 1949.

In the beginning, life was not easy for the Indonesian, due to internal affairs concerning separatism from various regions, rivalry in ideologies and fanaticism of religion. As a result of the political conflict within the country, a number of separatist movements exploited the population such as the so called 17 October 1952 affairs, Andi Azis, Kahar Muzakkar, RMS, DI/TII, PRRI/Permesta, and so on.

At that time, the Indonesian government was based on parliamentary democracy with a multiparty system. The political antagonism among political parties, plus armed rebellion in several areas, brought the country into chaos. During this situation the Indonesian Government could not concentrate its attention on economic development. During a period of fourteen years, the cabinet had changed seventeen

times. The " Demokrasi Terpimpin" (guided democracy) was introduced in this period by President Sukarno.
It was held that the executive, judicial and legislative bodies should be subordinated to the Head of State. It was also during this period that the Indonesian Communist Party, led by D.N Aidit, began to mobilize its supporters and infiltrate the country's institutions under the slogan of "Nasakom" (Nationalism, Religion and Communism) [Ref. 4].

This chaotic situation reached its culmination on September 30, 1965 when the Indonesian Communist Party launched a coup d'etat. This rebellion was crushed by the Indonesian Armed Forces, particularly by the leadership of General Suharto, the Commander of the Army Strategic Reserve Command (KOSTRAD). The communist ideology was banned and General Suharto became the President of the Republic of Indonesia in 1966.

These continuous unfavorable events might be understandable since Indonesia consists of more than 13,000 islands, 200 ethnical groups with the same number of cultures and languages, and five main religions among the people. This physical and cultural diversity, along with poorer educational systems under colonialism, were the main factors that influenced these internal conflicts.

After 1965, stability was gained and since then the government has begun to focus its attention on economic development in terms of national development.

B. NATIONAL DEVELOPMENT PLAN

The goal of national development is to have an economic structure based on a strong industry, which is supported by a strong agriculture as well [Ref. 5]. The ç al will be achieved by following a continuous stage of five year development programs, which were initiated in 1969, and the first five stage policy scheme is as follows [Ref. 6].

1969 - 1974 First Five Year Plan

Emphasis on establishing a foundation in the agriculture sector that is supported by the agricultural industry.

1974 - 1979 Second Five Year Plan

Emphasis on the agriculture sector that increases the industry of producing intermediate goods from raw materials.

1979 - 1984 Third Five Year Plan

Emphasis on the agriculture sector that increases the industry of producing finished goods from intermediate goods, and efforts toward a self sufficient food supply.

1984 - 1989 Fourth Five Year Plan

Emphasis on the agriculture sector in continuation of producing a sufficient food supply and establishing the basis of industrialization.

1989 - 1994 Fifth Five Year Development

Emphasis on the agriculture sector in establishing a self sufficient food supply and increasing other agricultural products. Emphasis on the industrial sector having relations with exporting products, labor intensives, agriculture processes and industrial machines.

C. THE NEED FOR TECHNOLOGY TRANSFER

Technology is needed to process any product either for the agricultural sector or for the industrial sector. In the beginning of the development program it was clear that technology was not yet available to conduct the Five Year Development Program properly. To develop the technology from internally would not be optimal. It would take a longer time and it might be obsolete by the time it had been completed. Other industrialized countries are already far ahead in the same field of technology.

Optimal efficiency and effectiveness are desired in the application of the development plan, so the appropriate advanced level of technology is required to achieve these objectives. The best way to obtain the technology is to transfer it from industrialized countries into Indonesia.

D. THE AREAS OF TECHNOLOGY TRANSFER

In transforming from an agricultural economic orientation to an industrial based economic structure, the government has developed an eight point technological and industrial platform. The areas have been highlighted during all the stages of the five year development plant.

The platform covers the following areas [Ref. 7]:

1. Land transportation industry.
2. Maritime and shipping industry.
3. Aircraft industry.
4. Electronic and telecommunication industry.
5. Energy industry.
6. Engineering industry.
7. Agricultural industry.
8. Defense industry.

The transformation itself is conducted in four overlapping stages. The first three stages are relevant to Indonesia as a developing nation and the last one is the key factor of survival in maintaining its position as an industrialized country [Ref. 8].

1. The first stage is a pure technology transfer through product license.

2. The second stage is the creation and production of new products for current demand by using the absorbed technology.

3. The third stage is developing new products for future demand.

4. The fourth stage is full scale basic research to maintain the previous 3 stages.

It is obvious that technology transfer is required explicitly in the first stage but it is also fully understood that technology transfer is also required during the rest of the stages.

IV. THE TECHNOLOGY TRANSFER LINKER MECHANISM

The government was fully aware that skilled labor forces, capital and technology were required in implementing the development plan. Identification of required technology will then determine both the capital and the required skilled personnel. There are many technologies available through out the world, so selection had to be made in order to adopt the most suitable to the Indonesian development program.

The Body of The Assessment and Application of Technology (BPPT) was created on 21 August 1978. The BPPT is directly under the control of the Minister of State for Research and Technology. Professor B.J Habibie is acting as the Chairman of the BPPT.

The main functions are as follows [Ref. 9] :

1. To create the atmosphere, control and evaluate the technology transfer program in Indonesia.

2. To develop the activities on the assessment and application of technology with the government and private sector institutions in cooperation with foreign countries.

3. To develop the basic and applied sciences in the framework of technology assessment to coordinate the application to technology and industry.

4. To provide the assessment, application and development of technology in order to increase quality in the infrastructure, industrial processes, electronic information system and to provide the respective facilities.

5. To provide the assessment, application and development of technology to utilize the natural resources for national development.

6. To provide the assessment, application and development of management and operations research, systems analysis, technology regulation and model simulation to support the national development.

7. To provide the development of the research worker's skill and to maintain the facilities to support the mission of the BPPT.

From this function, it can be concluded implicitly that, besides promoting technology transfer to Indonesia, the main role of the BPPT is to be the linker between the source of technology from outside the country and the user in Indonesia. It is interesting to note that the BPPT also has the responsibility to develop basic and applied sciences, which is indicated in the third function, and this goes beyond the basic linker function.

V. PROBLEMS AND CONTRIBUTIONS TO NATIONAL DEVELOPMENT

A. GENERAL

The BPPT has demonstrated its entire capacity as a linker between the source and the user of technology in Indonesia. It has taken considerable effort to contact and develop relationships with many industrialized countries, and at the same time is making efforts to contact and develop relationships with both government and private organizations in Indonesia to promote the technology transfer process.

During its activities to promote technology transfer, many problems have been discovered and handled appropriately. Important efforts that are beyond the transfer mechanism elements are also conducted by the BPPT. Additionally, the contributions to National Development as the result of the technology transfer process are also observed.

B. PROBLEMS

The problems of the transfer process will be described in the context of the technology transfer mechanism as described in Chapter II.

Organization

An organization can be characterized with respect to how it responds to the transfer process. The response could be slow, quick or no response at all. Many institutions were not readily prepared for the industrial environment [Ref. 10]. Indonesian educational systems, organizational structure, laws and regulations still reflect the agricultural, trading and service oriented society not of industrial or technological production.

Industrial environments need high efficiency supporting institutions. Many regulations and procedures have been adjusted in Indonesia to accommodate industrial activities and increase the speed of technology transfer. This encompasses enactment of modern legislation covering the various subjects considered important to proprietors of technology, relating to :

a. Recognition and enforcement of industrial property rights in patents, trademarks, trade secrets, and other forms of expertise.

b. Corporation laws permitting the formation of legal entities possessing characteristics suitable for the conduct of modern business.

c. Tax laws providing incentives for investments meeting established priorities, including relaxation of tariffs for the importation of necessary production equipment.

d. Guarantees against expropriation and other measures to safeguard industrial property.

e. Labor laws designed to promote industrial peace between workers and management and favorable working conditions.

Project

In transferring technology, the BPPT has adopted two criteria in adopting a new technology program [Ref. 11]. The first criteria is that the program should have a progressive production program, which means that the program should have the capacity to be divided into small programs. This is in order to achieve a deeper technological penetration into the constituents of the technology.

The second criteria is that the product should match with domestic needs, meaning that the market does exist so that the local producers may have the opportunities to improve their capacity.

Documentation

Another concern for technology transfer is that documentation be executed effectively in order to enhance the ease of technology transfer. The sources of the technologies are from various countries with different languages and, hence, all documentation for the purpose of technology transfer has been prepared in English. The reason is that English is the most popular language after the Indonesian language.

Capacity

Capacity is related to ability and capability. The degree of capability is largely measured by whether or not a person or organization can or cannot accomplish the assigned mission.

There are two constraints that influence the transfer capacity. The first constraint is the limited financial capacity of the user; thus, the programs have to be selected carefully according to their prioritization.

The second constraint is the inadequate numbers in the skilled labor force available to perform the new industrial activity. To solve this problem, the BBPT acts as the agency and sends people to be trained abroad to gain the required skills. Although a large number of trainees have been sent, and at the same time a large number of graduates have returned home, it must be realized that a certain length of time is still needed for better team work performance and practical experience.

Distribution

The BPPT is also acting as the distributor of information concerning technology. The information is passed to both government and private sector institutions. The BPPT arranges regular discussions on new technologies and invites all parties to participate. The source of technology, the user and BPPT get together to discuss the characteristics of the new technology and a follow up program of transferring the technology into the country is always possible.

Credibility

The culture of the society demands that the people are always loyal to the higher authority. The credibility of the BPPT is a significant factor in convincing the people of the

advantages or disadvantages of a certain technology. The credibility of the source is also an issue. It is assumed implicitly that the selected sources of technology have credibility.

The BPPT has proven itself by possessing the skill required as an intermediary, both in general knowledge and specific conditions [Ref. 13]. General knowledge includes understanding the relevant market, having good contacts and knowledge of the tools of the trade.

*1. **Understanding the relevant market**.*

The BPPT possesses knowledge of where there is a commercially viable need for the given product or process, and also has the ability to advise on which version of technology is most appropriate.

*2. **Good contacts**.*

There is no doubt that the BPPT personnel are composed of the best technocrats in the country that are widely known in local and international forums. This status provides the opportunity for the BPPT to have good contacts among both sources and users.

3. *Knowledge of the tools of the trade.*

There are literally dozens of strategies and legal forms that can be employed in the technology transfer process. The BPPT knows very well the selection of the approach to achieve the ultimate success of the transfer. An example in this context is the option to take a license in production of goods for the existing demands such as the production of BN-105 (helicopter), as well as joint ventures in developing goods for future demands such as the development of ATRA-90 (Advance Transport Regional Aircraft). Specific conditions include understanding the source of finance, and knowledge of contrasting cultures and economic conditions.

1. *Understanding the source of finance.*

There are numerous international and governmental institutions, some working in collaboration with private banking institutions, that can help finance various aspect of contemplated transactions. The BPPT has the knowledge and ingenuity for locating these institutions and procedures for applying for such assistance. With the assistance of the World Bank, an Overseas Fellowship Program has been launched to meet the staff requirements of the main scientific institutions in Indonesia [Ref. 15].

*2. **Knowledge of contrasting cultures and economic conditions**.*

All personnel of the BPPT are well selected Indonesian citizens who obviously understand history, cultural heritage, social institutions and political realities. This is one of the most valuable assets of all that the BPPT can bring into the technology transfer process.

Willingness

From the technology source point of view it is obvious that the main reason to transfer the technology is either political or economical. During the period that the relationship between Indonesia and the Eastern Countries was good, technology transfer existed in term of military assistance from those countries to Indonesia. After the communist ideology was banned in 1965, all kinds of assistance were stopped. This example shows how politics can drive the transfer of technology.

Ordinarily, the source will be willing to transfer its technology for economic reasons, mainly to expand the market and possibly to share research and development costs. In expanding the market, the source will transfer its technology as long as it will give benefits either directly or

indirectly. The cost of industrial research is mounting rapidly, as is the need to keep pace with one's competitor [Ref. 14]. The stakes get higher as the margin for error narrows. Technology transfer in the form of licensing can lower the risks of the technology game and increase the odds of success by expanding exposure of one's own invention, while increasing awareness of the innovations of others.

The user point of view is best described by observing the behavior of key personnel in the organization. The important characteristics of an organization to be observed in relation to technology transfer are the managerial climate and the attitudes toward bringing new ideas into the country. These have much to do with the personal perceptions of the decision makers on having new ideas, and those persons actually determine the speed of the technology transfer flow. Among decision makers there are different attitudes toward the necessity of technology transfer.

There are some people who believe that technology transfer is not an important issue since we are supposed not to depend on resources from outside the country. This is a view biased by the historical fact that Indonesia gained independence and still survives until now without adequate

technology. Hence, we will always survive and develop our own technology without necessarily transferring it from outside.

Some decision makers believe that since Indonesia has an enormous population, an intensive labor industry would fit the country. Since technology will reduce labor in general, these people believe that technology transfer will only need highly skilled personnel and could create an unemployment problem.

Other people believe that any technology transfer program can be measured in terms of cost benefits and they think that technology transfer is a waste if we fail to measure it that way. Most are aware that some benefits from transfer of technology are unquantifiable.

But still, there are also quite a number of people that strongly believe that technology transfer is really required for the sake of the future development of the country. The BPPT has to deal with different organizations, with different speeds of technology transfer flow, due to the different characteristics of decision makers.

Reward

It must be realized that we still need "push" and "pull" forces to accomplish transfer in relation to reward systems. The planned program is a push force, while the needs

that it generates are a pull force. The force behind it all is the reward for accomplishment. The five year development plan is the push force for technology transfer in Indonesia.

C. IMPORTANT EFFORTS BEYOND THE LINKER FUNCTION

Apart from handling the problems indicated through the linker function perspectives, and due to the special condition of Indonesia, there are also important efforts to be developed to enhance the transfer flow. The efforts are beyond the linker functions of the BPPT. Three efforts directly involve BPPT activity, while one effort involves governmental policy. The four important efforts are described as follows.

1. To ensure that science and technology move toward the desired goals of the National Development.

The selection of a particular need for technology by the end user is conducted through the research and development (R & D) process of the respective user's organization. Many programs of R & D are being conducted by end users whose organizations are not well coordinated. Overlapping programs, unbalanced research worker distribution, improper technical facilities, and low appreciation of the scientific community are some example of disadvantages that influence programs of R & D [Ref. 16]. A policy has been adopted by the government

to provide a regionally integrated laboratory to overcome the problems of R & D. the BPPT has the responsibility to coordinate and supervise these facilities.

The National Center for Science Research and Technology (PUSPITEK) was established in 1977, in Serpong southern Jakarta. Six laboratories are under the responsibility of the BPPT. They include : 1) Construction Testing Lab; 2) Engines, Propulsion and Thermodynamics Lab; 3) Aerodynamics, Gas-Dynamics and Vibration Lab; 4) Natural and Energy Resources Lab; 5) Process Technology Lab; and 6) Relief National Disaster Lab.

Similar facilities are prepared in different regions with different emphasizes on technology according to the industrial prospect of the region. For example, the Marine Engineering Laboratory is located in Surabaya, Coastal Engineering in Yogyakarta, and Bio-technology and Genetics Engineering in Cibinong.

2. To prepare the way for ready use of graduated engineers.

The number of graduated engineer in Indonesia is quite limited, up to the mid eighties there were not more than 40,000 graduated engineers. In Japan, for example, some 70,000 new engineers are graduating every year. In Indonesia,

although the plan is to graduate 15,000 per year, due to the lack of educational facilities the maximum output is only 7,000 graduates [Ref. 17]. The BPPT fully understands that for the process of industrial transformation a large number of engineers are required.

In order to reduce the scarcity of engineers, the BPPT has taken two steps, namely the development of the Overseas Fellowship Program (OFP) and the establishment of the Indonesia Institute of Technology (ITI).

a. The Overseas Fellowship Program.

With the assistance of the World Bank, this program meets the staff requirements of the main scientific institutions in Indonesia. The institutions include The Indonesian Institute of Science (LIPI), The National Institute for Aeronautics and Space Technology (LAPAN), The National Agency for Nuclear Energy (BATAN), The Agency for Coordination of National Survey and Mapping (BAKOSURTANAL), The Bureau of Statistics (BPS), and the BPPT.

Established in 1985, this training program envisages that in the year 1990 there will be 1,499 graduates, including 255 with a doctorate degree, 644 with master's degree, 300 with a bachelor's degree, and 300 non degree graduates [Ref.18].

b. The Indonesian Institute of Technology (ITI).

The ITI was founded in 1987 and is located next to the first integrated laboratory facility, The National Center for Science Research and Technology (PUSPITEK-Serpong). The courses offered are related closely to those at the existing laboratories of PUSPITEK-Serpong. There are no graduates from the ITI right now but the institute is expected to yield 'ready for use' graduate engineers in the near future.

3. To develop and integrate strategic industries.

The transformation process into an industrial nation needs a nation with a widely integrated technology transfer scheme. The integrated scheme could be achieved by the management of strategic industries that devote their technology, productivity, and efficiency to support the National Development.

Some activities in industry are considered to have characteristics of strategic industry. The activities include aircraft manufacturing, shipbuilding, weapon and ammunition industry, explosives production, steel production, telecommunications industry, rail road industry, construction and machinery industry and electronics industry.

There are nine state owned companies and one former production unit of a scientific institution whose activities are classified as strategic industries. These companies are under the management of the Agency for Strategic Industry (BPIS), which was initiated in 1980 and established in 1989. The chairman of BPIS is the President of the Republic of Indonesia and the Vice Chairman of BPIS is the Chairman of the BPPT.

4. To protect the products of technology.

Efforts have to be made to protect the products of technology transfer because the products have to compete with other goods in the market. The price of any product resulting from a technology transfer process is higher compared to its original price due to the following reasons [Ref. 20].

a. Labor costs.

Labor costs in Indonesia, with the same degree of skill, are only 10% of their counterpart in USA or Japan. On the other hand, only 1/3 of the total production costs is represented by the labor cost.

b. Technological Costs.

As long as the technology has to be imported from foreign countries and transferred into Indonesia, the costs of technology are higher than the normal portion of total costs. This is due to the responsibilities of using other's expertise and dealing with factors such as royalties, etc.

c. Material costs.

Materials that come from foreign countries require more transportation costs, insurance costs, warehouse and inventory costs due to the distance of the country's origin. During the transfer process it is unavoidable to import the materials from a foreign country.

To protect the products, the government policy is to become the main potential buyer of major products of the technology transfer process until low production cost is achieved and the products are ready to compete in the market. In addition, that government is also enhancing the function of its institutions to provide a healthy environment for the industry such as rights in patents, corporation laws, tax

laws, and labor laws as described previously in organization element problems. These elements appear as unavoidable costs.

D. CONTRIBUTION TO THE NATIONAL DEVELOPMENT

To examine the contribution of the technology transfer concept to the national development, one must observe the progress in the areas that had been determined by the government as transformational platforms towards industrialization. As previously described, the transformational areas include the Land Transportation Industry, the Maritime Industry, the Aircraft Industry, the Electronics and Telecommunication Industry, the Energy Industry, the Engineering Industry, the Agricultural Industry and the Defense Industry.

Before the creation of the BPPT, there already existed some activity in these areas. The difference is that there was no formal technology transfer strategy involved. Except the firms that are involved in the agricultural equipment industry, all other companies that now take part in such industrial activities are under the management of the Agency for the Strategic Industries (BPIS).

1. **The Land Transportation Industry.**

The technology transfer concept has been applied to the railway industry and a state owned company, PT INKA a Rollingstock Manufacturing Company, which was founded on May 18, 1981. The place where PT INKA started its initial activities was an old maintenance workshop for steam locomotives known as Madiun workshops and built almost a century ago during the Dutch colonization period. The only expertise involved is that of assembling a number of freight cars, rehabilitation of damaged passenger coaches, and overhaul of steam engines. Now the PT INKA mission is to execute manufacturing activities, mainly related to railways and offering supports in technical services.

In the beginning, PT INKA started with assembling semi-knocked down supplies, then moved to assembling completely knocked down supplies, and finally entered the complete manufacturing stage. PT INKA has shown its capability in the construction of 400 wagons, consisting of 150 coal hopper cars and 250 palm oil tank cars that were begun in August 1982 and finished according to plan on August 1983. Between 1984 and 1988, the production improved to producing 600 freight cars and 60 passenger cars annually. From 1989 and onward, the plan is to improve capability further by

producing 10 sets of diesel rail cars and 5 sets of electric rail cars annually. The sources of this technology are Japan and West Germany.

2. **The Maritime and Shipping Industry**.

PT PAL, is a state owned company, which was established on April 15, 1980. Similar to the railways industry, PT PAL activities started by using an old repair and maintenance facility for the Indonesian Navy in Surabaya, which was built by the Dutch in 1849.

In the framework of the technology transfer concept, this company was involved in maritime and shipping industries activities with the following responsibilities.

a. As the center of production, repair, and maintenance of the shipbuilding industry, as well as support for the national defense and security.

b. As the center of industry in support to the national maritime industry.

c. As the center of research and development of the national maritime industry.

The production of warships is managed by the warship division of PT PAL which, at its initial stage, carried and transferred technology through producing fast patrol boats and jet foil boats with contract license from the Lurssen shipyard in Germany and the Boeing Marine System in the United States.

Through design and engineering cooperation with another source of technology, not a licence contractor, the succeeding program was prepared for design and engineering as well as production. The programs covered the production of a 2,000 ton Frigate, a 600 ton Mine Sweeper, a 1,200 ton Submarine, FPB-28 and FPB-57 Patrol boats, and Jet Foil Boats.

The production of commercial ships is managed by a commercial ship division of PT PAL. Two units of 3,500 DWT tankers, two units of 3,000 DWT Caraka Jaya ships, one Utility Vessel for Offshore Drilling Activities,two 2,400 HP Tug Boats, and 5,000 TLC Floating Dock have been built by PT PAL. The next advanced program in shipbuilding technology is the design and production of Caraka Jaya I & II, 5,700 M3 LPG Carrier and 3,000 DWT General Purpose Cargoship.

3. **The Aircraft Industry.**

PT IPTN, Indonesian Aircraft Industry-Nusantara, was established on 23 August 1976 using an old airstrip plus an Air Force maintenance Facility in Bandung. PT IPTN is actually a big step toward the era of industrialization where the transformation stages from a simple Air Force facility into a significant aircraft industry can be observed clearly.

The first stage of transformation, namely the production under license agreement, had been conducted successfully by producing small passenger aircraft, NX-100 Aviocar from Spain, and helicopters NBO-105 from West Germany, NBell-412 from USA, and NSA-330 & NSA-332 from France. From these experiences, PT IPTN established a full manufacturing capability.

The second stage was to design and produce a new type of aircraft CN-235, that seats 33-44 people. The commuter was developed by PT IPTN in cooperation with CASA Aircraft Industry from Spain. Still in the same framework of design and production of new types of aircraft, PT IPTN is now cooperating with the MBB Aircraft Industry from Germany in developing helicopter BN-109.

PT IPTN has also had remarkable success in the development of technology in the aircraft industry. The

technological progress includes the use of advanced composite material for future aircraft, the creation of a rain making configuration in the aircraft used for this purpose, and 35% offset production of F-16 fighters for the Indonesian Air Force.

PT IPTN has been given a factor of 2.5 in technology transfer in regard to the offset production of the F-16 from General Dynamics. The factors range from 1 to 15. General Dynamics, which has fully mastered the technology, is the only industry that possesses factor 1, while an industry with the poorest technological skills would be rated a factor of 15. Normally developing nations are rated between 12 and 15.

The PT IPTN has already entered the third stage of its industrial transformation, namely to design and produce aircraft for future market demand. PT IPTN organizes cooperation with MBB (West Germany), Boeing (United States) and Fokker (Netherlands) to design and produce the ATRA-90 (Advance Technology Regional Aircraft) a propfan type aircraft with a capacity of 100-135 seats. This aircraft is designed to fulfill the regional requirements in the year 2000.

4. The Electronic and Telecommunication Industry.

PT INTI is a state owned company producing telecommunication instruments and equipment. The embryo of PT INTI is an old state telecommunication laboratory that was set up in 1925. PT INTI was established in 30 December 1974.

PT INTI, with its modern plant in Bandung, has established an adequate capacity to meet Indonesia's need for telecommunications industry products. The annual capacity of the plant covers 150,000 line-units of digit•1 telephone stations, 5,000 line units of automatic direct-dialling telephone stations, 15,000 telephone sets and 3,000 units of public telephones. PT INTI also has the capacity to produce 25 units of small earth satellite stations, 1,000 line units of long distance telephone stations, 10,800 channels of MUX/PCM and 20 units of microwave stations.

5. The Energy Industry.

Under the initiative of the BPPT, a new field of energy alternatives are being explored. Most of the activities are small scale applications of new technology for the purpose of research and development such as the following.

a. In the field of photovoltaic engineering, study, trial, and development of solar cell application had

been implemented in remote places where electrical facilities are not available. The areas include, Picon Cituis and Gunung Kidul villages in Java island, and several villages in Sumba and Timor Timur islands.

b. Study in chemical conversion and combustion technology is being conducted in Serpong and Picon.

c. Solar thermal pumps have been installed in a village in Lombok island, and in Bogor and Serpong, which are both in Java island.

d. Minihidro, small waterfall generators, have also been installed in Purwakarta and Malang, Java island, and in a village in West Sumatra island. Performance of those machines is being observed for technical and economic evaluations.

6. **The Engineering Industry.**

Previously, industrial plants were designed and built by foreign companies. Effort is being made to command the knowledge of the integrated design and erection of our own industrial plants.

Currently, PT BARATA INDONESIA is cooperating with Japan's Kawasaki in conducting the first phase of its progressive development program, which involves licenced manufacture for engineering works. Hydro powerplants in Bandung and Batang Agam, Steam Power Plants in Jakarta, Surabaya, and Palembang are some examples of the results under the concept of technology transfer. Efforts in mastering the design of integrated factories for sugar plants, cement plants ,etc., are also being conducted.

7. **The Agricultural Equipment Industry**.

Except for big tractors, which still have to be imported, the technological capabilities of the domestic agricultural equipment industry is adequately advanced to produce various kind of agricultural equipment.

Hand tractors, mini-tractors, irrigation pumps, sprayers, rice-threshers, rice hollering and polishing machines, huller plants, etc. are examples of agricultural equipment that now can be produced in Indonesia. Most of industries involved in this particular field such as manufacturers, assemblers or sole agents are firms from the private sector.

8. The Defense Industry.

The production of naval vessels is conducted by PT PAL, and the military version of helicopters and aircraft are produced by PT IPTN. An army workshop, PINDAD in Bandung, is the only activity that has been involved in light arms technology since 1960. However , the massive and systematic development of light arms technology began when Indonesia decided to make its own rifles with a license from the FN Herstal from Belgium. The technology for manufacturing these rifles is being applied by PT PINDAD, which since 1983 has been given the status of a state owned corporation.

In addition to its facilities for the construction of aircraft, PT IPTN has a weapon division that produces rockets and torpedoes. Sura D rockets are manufactured under license from the Swiss Oerlikon Company, and 2.75 " FFAR (Fin Folding Aircraft Rockets), are manufactured under a license from a Belgium company. This division is also manufacturing torpedoes on a license from AEG Telefunken, West Germany.

It can be noted that a wide spectrum of technology has been applied for the transformation towards industrialization. All the progress that has been achieved in each transformational industry is the result of the direct

involvement of the BPPT in promoting the technology transfer process in Indonesia.

VI. CONCLUSION AND RECOMMENDATION

A. CONCLUSION

The role of the BPPT is to serve as the linker between the source of technology from foreign countries and the user in Indonesia, as well as to harmonize the elements of the transfer mechanism in the technology transfer process.

Project, Documentation and Distribution are the formal elements of the transfer mechanism that are relatively identifiable and manageable by the BPPT. While Organization, as the other element of transfer mechanism is relatively identifiable, much of it is handled by the government. The development of institutions that support the industrial activities serve as examples.

Willingness is the informal element of the transfer mechanism that is not clearly identifiable nor manageable by the BPPT. The level of education and past experience of the society influence the willingness to transfer the technology. The willingness will increase naturally and in parallel with the maturation of the society.

The Linker, Credibility and Reward Systems, are other informal elements of the transfer mechanism that are managed by the BPPT successfully.

The BPPT is also actively involved in increasing the capacity of the user as the other informal element of the transfer mechanism. The Overseas Fellowship Program and the establishment of the Indonesia Institute of Technology are examples of this activity.

The BPPT also makes efforts that go beyond linker function definitions, such as ensuring that science and technology are moving toward the desired goals of the National Development and integrating the strategic industries in Indonesia. All of these activities are in the scenario to transform the society into an industrial oriented nation.

The technology transfer flow is characterized by the speed and the smoothness of the flow. Despite the complexity of the problems in the context of the transfer mechanism and a relative period of time scale, the appropriate level of smoothness and speed of transfer flow has been achieved.

In a relatively short period , since the creation of the BPPT in 28 September 1987 until the present time, many technology transfer applications for the purpose of the National Development have been conducted successfully. A wide

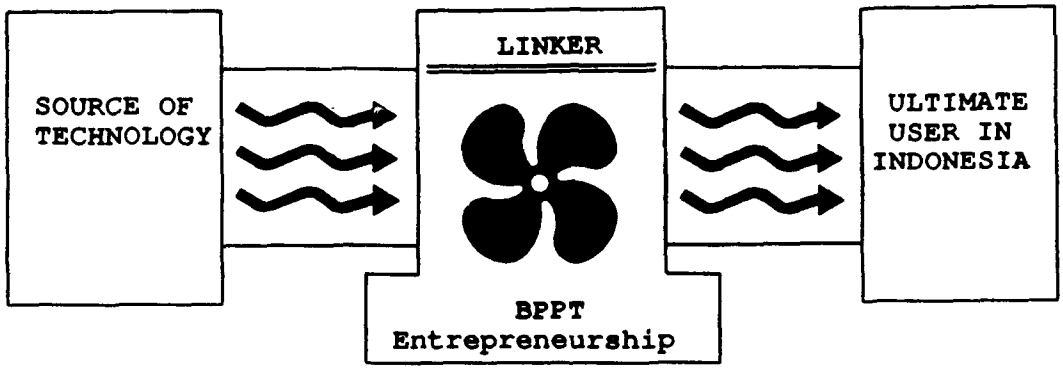
variety of technological innovations ranging from the simple hand tractors to advanced technology aircraft have been introduced and implemented.

Mastering the technology after having experience with the application of the transfer is the next most important goal of the transfer process. In certain technological areas, such as in aircraft technology, the mastery of the technology indicates impressive progress. The factor of 2.5 that has been given to PT IPTN in regard to the offset production of the F-16 supports success in this area.

B. RECOMMENDATION

It is apparent that the success of technological innovation in Indonesia is the reflection of an excellent combination of the entrepreneurial, managerial and technological roles of the BPPT and the industries that now utilize the technologies. While the managerial and technological roles are important for execution of the programs of technology transfer, the entrepreneurial role is essential for technological innovations [Ref. 21].

The entrepreneurial role of the BPPT in the transfer process can be visualized in the following diagram.



KNOWLEDGE ----------> TRANSFORMATION ----------> INNOVATION

Fig. 3 Visualization of the entrepreneurial role in the transfer process.

The highest credit should be given to Prof. B.J Habibie for his great inspirations, continuous efforts and dedication to the innovation of technology in Indonesia. In his capacity as the chairman of the BPPT, and as the chairman of all other associated organizations that configured the linker network in the technology transfer process, he has proven himself as the first gigantic entrepreneur of technological innovation in Indonesia. It is beyond any doubt that the existence of Prof. B.J Habibie is the dominant factor in all of the successful existing technological innovations.

It must be realized that a time horizon is the most essential and difficult issue for any major innovation [Ref. 22]. For example, Japan needed one century from the Meiji period to enter the present industrial era [Ref. 23]. Additionally, innovative projects go beyond simple economic

performance measurements [Ref. 24] and not many decision makers in Indonesia are aware of this phenomena. Further, the environment that supports the industrial activities is still in a development process. Hence, a continuous entrepreneurship is needed for the survival and growth of the existing industries. This need could be achieved by maintaining the existing entrepreneurial environment in the BPPT and its linker networks, such as the Agency for Strategic Industry (BPIS), and the Centers for Science and Technology Research (PUSPITEK).

There are three important elements that need to be developed to maintain an entrepreneurial environment in BPPT and its linker networks. These elements are adaptability, entrepreneurial culture and "hands-on" top management [Ref. 25].

1. **Adaptability.**

The BPPT and its linker networks have to balance a well-defined technological focus with the willingness, and the will, to undertake major and rapid change when necessary. Technology can change rapidly, and a high mobility is required. Therefore, the BPPT and its linker networks must be able to trade and exploit the rapid shifts and twists in market boundaries as they are redefined by new technologies,

markets, and competitive development. Organizational flexibility is the consequence of mobility, hence, frequent realignments of people and responsibilities will be needed as the institution attempts to maintain its balance in a shifting competitive environment.

2. **Entrepreneurial Culture.**

While continuously striving to pull the organization together, fierce activism has to be displayed in promoting internal agents of change. Excellent communication networks within the BPPT and its linker networks, as well as tolerance of failure, are additional factors to be developed in the BPPT in order to maintain its entrepreneurial culture.

3. **"Hands-on" Top Management.**

The Executive Officers of the BPPT and its linker network divisions have to be actively involved in the innovation process. The fundament of each divisional activity should be mastered at a level such that all Executive Officers can directly interact with their people about it. Those key personnel have to be able to explore, encourage and promote the potential change agents from within the BPPT and its linker networks to maintain the entrepreneurial environment.

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